

INDO-AFRICA RELATIONSHIP: OPPORTUNITIES FOR TECHNOLOGY TRANSFER BETWEEN INDIA AND AFRICAN COUNTRIES

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1.0 INTRODUCTION

1.1 Historical background

The Indo-Africa relationship is distinctive and owes its origins to a common past that they share, a past that witnessed a struggle against colonialism, poverty and illiteracy. India and the African nations have been building strong and mutually beneficial associations since long. India established its trade relations with the African countries as long back as in the 14th century. As emerging economies, India and Africa have a lot in common - rich natural resources, similar demography and large domestic markets. This provides a natural synergy for building partnerships (Walters, D., 2010).

Moreover Africa has been part of India's foreign policy since 1950s. However, since the beginning of the new millennia, India has again acknowledged the importance of African countries in global governance, trade, and cooperation. India's cooperation with African countries has recently been scaled-up and publicized. Indo-Africa trade increased from \$967 million in 1991 to more than \$9.5 billion in 2005. From 2000 to 2009, Indian exports to Africa increased from \$2 billion to \$14.813 billion, and imports from India to Africa increased from \$3 billion to \$24.728 billion. India's official foreign direct investment in Africa in 2008 was \$2billion. India's trade with Africa almost doubled to 7.7 per cent of its total trade between 1990/1 and 2006/7 in contrast to other countries.

In line with the above statement, technology transfer has been a great issue of concern for researchers, companies and policy makers. The transfer of Knowledge is a key tool of technology transfer; technology cannot be transferred if there is no knowledge involved. Therefore, knowledge and technology transfer have to work together at the same rate of development to achieve transfer. One of the essential benefits that arise from technological transfer is the globalization of industries; through it, the world comes together as one large market place. In recent years, India's economic partnership with the African countries has been lively, extending beyond trade and investment to technology transfers, knowledge sharing, and skills development. Persistent efforts are being put in at the government level as well as the private sector level, for a comprehensive engagement, to march together as partners in progress. The First India-Africa Forum Summit in 2008 at New Delhi was a stepping stone towards that direction.

On March 2010 the confederation of Indian Industries (CII) with EXIM (Export-Import) Bank of India and with the support of the Indian government hosted a meeting with 34 African countries, judged as a "platform to help create a long-term vision for economic engagement between Indian and African economies". The former Indian Minister of Foreign Affairs, Shashi Tharoor, rightly argued that India's model of engagement with the African continent revolves around capacity building, training and private sector investment (Walters, D., 2010). Amongst the most interesting cases of the technology transfer from India include the move by India's top telecommunications player Bharti Airtel to acquire the African assets of Kuwait's Zain, the biggest venture of a domestic company into the African continent.

However Airtel's buyout of Zain's African assets is not only a mere indicator of the growing strength of the Indian telecommunications industry (Indian telecommunications company, Essar, has launched its own YU brand in Kenya and is also planning to be a pan-African player), but also emphasizes the increasing importance of Africa as an investment destination and market for Indian goods and services.

The increase in technology transfer from India has generated small-to medium-scale activities, which are generally labor-intensive and often rely more on local than expatriate personnel, with a high potential for backward and forward linkages and the diffusion of technologies and knowhow that is more appropriate for the needs of African countries. Among the current debates is whether African economies can sustain the benefit from the technology transfer from India, especially on the potential impact of India investments in ensuring a holistic technology transfer to create a highly skilled African manpower. Therefore, this desk review paper will, try to analyze the technology transfer brought in Africa from India.

1.2 About Technology and Knowledge Transfer

Even though technology transfer is not a new business phenomenon, the considerable literature on technology transfer that has emerged over the years agrees that defining technology transfer is difficult due to the complexity of the technology transfer process (Robinson 1997). The definitions depend on how the user defines technology and in what context (Chen 1996; Bozeman 2000). However, technology transfer can be defined as the processes by which technological knowledge moves within or between organizations and can be referred to international technology transfer when it occurs between countries (see endnote)¹.

The movement may involve physical assets, know-how, and technical knowledge. Technology transfer is an important means by which developing countries gain access to technologies that are new to them. The process can involve licensing agreements or setting up joint ventures and partnerships to share both the risks and rewards of bringing new technologies. The technological knowledge that is transferred can assume various forms.

It can be embodied in goods (including physical goods, plant and animal organisms), services and people, and organizational arrangements, or codified in blueprints, designs, technical documents, and the content of numerous types of training. However the ability of the countries to adapt the imported technology to develop their own version is at the core of the ultimate benefit for any process of knowledge and technology transfer. Closely linked to technology transfer is knowledge transfer, which is not necessarily synonymous to technology transfer. Knowledge transfer can be defined as a process of knowledge creation and application, knowledge mobilization and exchange, information search and transformation as well as the learning process at and outside the workplace (Davenport and Prusak, 1998) (See endnote2).

Indeed, many of studies do not draw a clear line between knowledge and technology transfer because most of them have regularly applied the term interchangeably. The majority have treated knowledge transfer and technology transfer as having similar meaning. Based on various definitions from different disciplines of research and background, majority of researchers have affirmed that technology transfer is closely associated with the transfer of

information, know-how, technical knowledge which is embodied in the products.

1.3 Significance of the study

This desk review paper attempts to assess the technology transfer from India by looking at both direct and indirect transfers, in order to identify some potential benefits to Africa, suggest priority areas in facilitating the transfers, and suggest further studies and interrogation on the subject matter. It is hoped that the recommendations will be helpful to policy makers of African governments in defining how Africa should reposition itself to gain from India's political will to enhance trade and physiological transfer between the two sides.

1.4 Objectives/Aim

Due to India's growing economy, the appetite of its public and private sector enterprises for investment overseas, using its leadership in science and technology, have together shaped its policy towards Africa. As such, India is focused on intensifying economic and commercial ties whilst contributing to African countries' development through co-operation and technical assistance. The aim of this paper is therefore to assemble evidence of existing and potential benefits in technology transfer between India and African countries and how can the countries benefit directly or indirectly from the transfers. It is premised on a prior understanding that at the moment there appears to be a one-way flow: India to Africa direction. Before proceeding further with the paper, there is a need to look on the ways technology transfer can be diffused to the African countries. This would include:-

- a) Transfer through training, learning by doing, learning by interacting, and job mobility. Some of the trainings are provided in host country institutes, such as IMTU in Tanzania, TATA in South Africa, and other trainings take place in India by hosting African experts in India.
- b) India linked multinationals and corporation (MNCs) ventures with African Firms.
- c) Demonstration effects as local firms copy or adapt new technologies, market channels and management techniques introduced by Indians. This can take place in activities that involve processing or manufacturing and also services such as Airtel, Bank of Baroda, YU in Uganda Oil and National Gas Corporation (ONGC) in Libya, Nigeria and Mozambique.
- d) Transfers can also be seen through exchange of people in terms of business people, traders and health services such as Lions club.

Taking into consideration of the above mentioned ways of technology transfer from India to Africa, the study assumes that there are technological transfers adapted to Africa as shown in the next chapter.

2.0 EVIDENCE OF TECHNOLOGY AND KNOWLEDGE TRANSFER

Findings from many authors have underscored that there is plenty of technological transfers taking place to various sectors of the economy in African countries as shown below.

2.1 Direct Technology Transfers

A significant number of African countries have collaborated with India to build key development and governance institutions in areas such as agriculture, foreign trade, micro finance, entrepreneurship development, infrastructure building and health care, to mention a few. All these can be seen as the efforts to transfer technology directly to Africa.

2.1.1 Education

Education is one of the areas India has managed to invest considerably as part of technology transfer to the African continent. A good example is the Pan African e-Network Project, which comprises twelve African countries: Botswana, Burundi, Cote d'Ivoire, Djibouti, Egypt, Eritrea, Libya, Malawi, Mozambique, Somalia, Uganda and Zambia. It is the biggest project of distance education and tele-medicine undertaken in Africa, with more countries set to join later. The basic objective of the Pan-African e-Network project is to assist Africa in capacity building through imparting quality education to 10,000 students in Africa over a 5-year period in various disciplines from some of the best Indian Universities and Educational Institutions (Abdul Kalam, 2011).

In addition to the Pan-African e-Network, India has also extended assistance to several African nations by way of training of experts and implementation of projects. About 15,000 African students are currently enrolled in India, pursuing different academic programmes at different levels. There are also plans to establish a series of India-Africa institutes, each specializing in different areas such as foreign trade, education, administration technology and human settlements as part of future capacity building (ASA News brief, 2010). There are some private-sector led initiatives in learning such as St. Joseph University of Tanzania and the International Medical and Technical University, also in Tanzania, with their staff comprising of Indians, Tanzanians and other African nationals, who offer different courses.

However there appears to be relatively more government to government initiatives between the government of India and the African governments on technology transfer. This can be evidenced by the more than 3,000 people from Africa including parliamentarians, civil servants and technocrats who visit India for various training and capacity building programmes each year (India Africa 2009). The support offered by India to transform the Dar es Salaam Institute of Technology (DIT) in Tanzania as a centre of excellence in ICT in East Africa is also a notable initiative in this regard.

The main focus of Indian Technical and Economic Cooperation programme is on capacity building and skills transfer to hundreds of thousands of students, professionals, and mid-

career diplomats in more than 160 countries across continents, including Africa. Since its establishment in 1964, the government of India has provided technical assistance to developing countries worth around US\$ 2.5 billion, out of which around US\$1 billion was spent for Africa (Chand, M., 2011). During the 2008 India-Africa summit, India's Prime Minister, Manmohan Singh, announced additional 500 slots for African students as well as doubling long term scholarships for undergraduates, postgraduates and even to higher courses.

Moreover, India is expecting to extend about 22,000 scholarships for the next 3 years to African students and professionals to help them become change agents to lead their respective societies to a better future. One good example is the empowering of the local African crafts communities through design intervention¹. In 2008 the programme established a solar lantern project that was initially supported by the UNDP in Ethiopia. The project envisaged to reach more than 150 women from different parts of Africa, such as Namibia, Tanzania, Sudan and Senegal. In 2010 the Indian government initiated a process of adopting a policy that will permit foreign universities to enter the higher education system in India by establishing their own campus or joint venture with existing universities and institutes, through which in turn the policy will result into transfer of technology (UNESCO Science report, 2010).

2.1.2 Health sector

India has emerged as a global healthcare provider because of its ability to offer world-class expertise at relatively low cost. There has been a proliferation of new healthcare facilities at private centers of medical excellence in Mumbai specifically. High class medical infrastructure facilities, coupled with improved and cheaper air connections and easy access to visa facilities, are some of the factors that have contributed to the emerging scenario (Reni, M., 2011). On the other side, the health sector in Africa has also been among the beneficiaries of technological transfers from India. The sector has experienced exchange of expertise like doctors, patients, facilities such as medicine, and also through establishment of local hospitals and health related institutions. A good example is in Tanzania, where there are programmes for exchange of patients with heart problems through the Lions Club/Apollo hospital in New Delhi and International Medical and Technical University (IMTU) and Lugalo Military Referral Hospital in Dar es Salaam.

Through the Pan African E-Network, the African continent has seen great achievements in the health sector, coupled with regular tele-medicine consultations from the best hospitals in India. In addition to that, Continued Medical Education (CME) sessions were established in 2009 from more than 10 super specialty hospitals in India from which more than 1,500 CME sessions had been conducted by mid-2011 (Abdul Kalam, A.P.J., 2011). Over the past three decades, about 2,000 heart surgeries have been facilitated in Indian hospitals, offering medical services of international quality standards and near to 100 per cent success rate (about 99 per cent), at one-third the cost of similar surgery in developed nations. This implies such exchanges have saved the African continent huge amounts of funds, which can be allocated to other development activities.

In Tanzania, every year 50 children are sent to Mumbai through the sponsorship of the

¹ <http://www.indiafrica.in/ProjectBackground.html>

Lions Club, Dar es Salaam and the Ministry of Health in Tanzania. Over the past few years about 1,000 Tanzanian patients have sought treatment at the Apollo Hospital in Hyderabad, the Madras Medical Mission in Chennai, and the Narayan Hrudalaya Heart Institute in Bangalore, under the guidance of the internationally reputed heart surgeons, such as Dr Devi Shetty and Dr K.M. Cherian. Additionally, the former president of India, Dr Abdul Kalam, in his capacity as patron of the Care Hospital in Hyderabad, donated ten free heart surgeries for Tanzanian patients.

He also offered cardiac surgery training to government doctors, who were identified through the Tanzania Ministry of Health at the same hospital. Further technology transfers can be seen through the success by some Indian companies which have recently introduced new drugs to the African market. For example, in the spring of 2012, Ranbaxy introduced a new anti-malarial drug, Synriam. It is claimed to have a 95% cure rate and relieve symptoms of the illness. In September, Cipla's new proposed drug to combat malaria was approved by the World Health Organization as well (Reni, M., 2011). This is an important intervention because in most of the African countries, and Tanzania in particular, malaria claims more lives than HIV-AIDS and TB combined.

There is also a plan to set up a 500-bed hospital in Dar es Salaam Tanzania to serve patients from East and West Africa, which will require an investment of US \$70 million. This will reduce the cost further because so far Apollo Hospitals report that around 35,000 African patients have already travelled to India to get treatment in their hospitals over the past few years. As part of technology transfer, several Apollo Hospitals in India were the first in African countries, including Tanzania, to receive international healthcare accreditation, being approved by the prestigious US-based Joint Commission International (JCI) whereby it will boost the African technology transfer (New Africa 2012). For further investment, and of course technology transfer in the health sector, India has planned an African expansion programme, aiming to build hospitals in Tanzania, Botswana and Nigeria. This move will certainly boost competition as well as quality of the services, which should most probably lead to technology adoption and adaptation.

2.1.3 Telecommunication

Some technology transfer has certainly happened through the Indian investors in the telecommunication industry, which has taken place in 13 countries including Uganda, Kenya, Congo and Tanzania. Among the most visible examples in East Africa are Bhati Airtel which took over the Zain assets and also the launch of YU brand by the Essar telecommunication company of India. The Indian companies have provided employment in the host countries and also trained workers. Through Corporate Social Responsibility to different levels of the society, they have facilitated provision of basic services in education, health and water for the poor. In 2009, TATA Communications, a leading provider of internet communications services, signed a landmark deal with local ISP Access Kenya to establish a Tier-1 Internet Point of Presence (PoP), a project which was intended to ease access to the internet for African firms (Telecom Africa).

This project has enhanced Kenya's capacity in internet service technology marking an evident transfer of technology from India to Africa, of course taking advantage of the fibre-optic connectivity between the two continents. Besides mobile telephony, India has also

helped to fund the development of various projects across Africa, such as its ambitious Pan-African e-Network Project, which was developed jointly by the Indian government and the African Union to promote online education and telemedicine programs across the continent. For this purpose, a memorandum of understanding (MoU) was signed in October 2005 between the AU and India. Furthermore, India's IT firms (e.g. Aes Technologies; IC India, Karro Technologies, Eastern Software Systems, and Covina and Newgen Software) had explored acquisition opportunities in the African telecommunications market, which was forecast to reach a value of around US\$ 22.5 billion by 2010.

As far back as in 1977, the Government of Tanzania and India agreed to promote small-scale industrial development in Tanzania, under the Indo-Tanzania programme, whereby a loan of US\$ 4 million was granted to buy machines (from India) and train staff in India (Kavishe, 1999). Further benefit of Technology transfer is evident in Tanzania, with the government of India setting up Small Industries Information Center (SIIC) and supplying hardware, software, along with the development of the SME web, which helped to create and integrate online information sources on relevant areas of Tanzania SMEs. Through the help of Indian expertise, the micro small and medium enterprises of Tanzania have access to information on technology, marketing and investment within and outside of Tanzania.

2.1.4 Pharmaceutical industry

India's pharmaceutical industries have built a credible track record using technology transfer to help improve African countries' ability to use new medicines, by strengthening the expertise of the local scientific and medical communities. It is expected that at the end of 2015 the pharmaceutical industry in Africa will be worth US\$20 billion. The main pharmaceutical industry players with the biggest presence in Africa are Ranbaxy, Cipla and Dr.Reddys. Where possible they participate in improving the health infrastructure. However, the success of technology transfer depends on certain critical factors such as political stability, good economic governance, clear development priorities and effective regulation. So far, pharmaceutical companies such as Ranbaxy Laboratories Limited have established a strong presence in many African countries, including South Africa where they aim to provide a wide range of quality and affordable generic drugs to the people.

In 2008 a joint venture between CIPLA, the government of Uganda, and Ugandan pharmaceutical manufacturer Quality Chemicals Industries (QCI) Ltd, established a US\$ 32 billion new plant in Kampala to produce anti-retroviral and anti-malaria drugs. In this way QCI was able to leverage Indian technology and expertise to ensure that the manufactured drugs meet the highest international standards (AfDB, 2011). Pharmaceutical companies such as Ranbaxy are also looking beyond South African borders and are eager to strengthen their presence in other countries such as Nigeria and Morocco.

2.1.5 Transport Sector

India has also played a commendable role in transferring technology to African countries in the transport sector. A good example can be reflected in the establishment of a car plant in South Africa by TATA Company of India, where it established its headquarters for all TATA operations in Africa. Training, skills transfer and development of South African workforce was one of the Tata Group's top priorities. Mr. Raman Dhawan, the Managing Director

of Tata Africa stated that: *“Tata Motors South Africa is committed to ensuring that skill levels of individuals employed in various industrial trades, such as auto mechanic, welder, painter etc, are further enhanced.”* In fulfilling their word, Tata established a state-of-the-art technical training centre in Germiston, Johannesburg, operating since 2006, for skill development of dealer mechanics in South Africa. It has plans of opening up this type of training in various other countries on the continent. Based on its success in South Africa, Tata motors has opened dealerships in neighborhood Botswana, Lesotho and Namibia, and aims to increase its Southern African dealerships which would result into absorption of the technology in these African countries.²

In the last financial year (2011/12), Africa and Middle East imported 48% of Bajaj Auto's exports, with Africa as the largest destination. The level is expected to double in the next 2-3 years. Bajaj Auto has lately increased its presence in Nigeria, Uganda, Kenya and Angola. A news report on allAfrica.com, indicates that the company has now started simple assembly of some parts at its plant in Mikocheni Industrial area, Dar es Salaam, Tanzania. The plant is expected to create 500 direct jobs in the country. Moreover, Bajaj Auto plans to invest \$20 million in the Tanzania assembly plant, and the head of international Business at Bajaj Auto Mr. Rakesh Sharma insisted that *“Bajaj Auto will give technical support and export equipment to our distribution partner in various countries”* According to that report, Bajaj has been doing well in Africa. Assembling vehicles in Tanzania will help to expand technology and its operations³.

2.2 Indirect Technology Transfers

2.2.1 Agriculture

Agriculture is Africa's most important economic sector. It employs more than half the labour force; yet it remains one-fourth as productive as in the rest of the world. One of the recent surveys of this huge sector concluded that part of that productivity gap can be explained by the fact that nearly two-thirds of Africa's agricultural land has been degraded by erosion and other factors such as misused agro-chemicals. In this circumstance, India expertise in agro-processing and small farm mechanization⁴ is of relevance to Africa's farming industry: it can help African countries address both food security crisis and unemployment problems.

Indian investments are not only useful in improving farm technologies and productivity in Africa; they are also promoting agro-business through technical assistance and skills transfers in order to improve the quality of infrastructure, increase access to microfinance, and scale up local entrepreneurship (small scale and gender based). For instance, the Indian government line of credit worth of US\$ 15 million in Sierra Leone for the development of commercial agriculture, to be applied on purchase of agricultural machinery and equipment, will certainly address Sierra Leone's under-exploitation of agriculture resources and consequently its food insecurity (AfDB, 2011).

In East Africa, the Tata group has been given a land lease in Uganda to run a pilot agricultural project, while the Jaipurias of RJ Corp have a lease of a 50-acre model dairy farm. The latter

2 <http://www.southafrica.info/business/investing/tata250711.htm#.UUAN7B2VPAM#ixzz2NOmsRA5>

3 http://www.dnaindia.com/money/report_bajaj-crank-up-africa-ops-with-tanzania-assembly_1582208

4 for example manufacturing and export of agriculture tractors, seed cum fertilizers drills

is already active in dairy products in African markets such as Uganda and Kenya. Another Company Shapoorji Pallonji & Co has acquired the lease for 50,000 hectares of land in Ethiopia, which will be used for agricultural projects in the future. Furthermore, McLeod Russel India, which is one of the largest integrated tea companies in the world, has shown interest to invest in agriculture in Africa.

Among the company's interests is to acquire Uganda's Ruwenzori Tea Investments, one of the biggest tea plantations in Uganda having up to six estates with a capacity to produce 15 million kilograms of tea annually. Further interest is being shown by a group of Punjab-based farmers from India who intends to acquire on lease around 50,000 hectares of farm land in Ethiopia⁵. India and Botswana cooperation which started a few years back can also be an indicator of technology transfer through agriculture, livestock and human resources development.. For instance Indian seeds (maize and paddy rice) have been sent to Botswana for experimentation; and a project for importing Indian Buffalos to the country was set up in the late 1990's. The most recent development includes a tender for the purchase of Indian tractors on a large scale, a project that embodies technological transfer as well (Suresh, K., 2012).

2.2.2 Oil and Gas

Another area of Indian investments in Africa is in the of Oil and Gas sector. For instance in 2010, Angola and India state oil companies signed a deal to boost cooperation in exploration and refining in the two countries. In oil-rich Nigeria, as a step towards its entry into Africa's energy fields, India has also expressed the desire to develop refineries, natural gas and liquefied natural gas (LNG) projects. During a visit to this African country in January 2010, India's Minister of Petroleum, Murli Deora, stated that India is committed to invest more than US\$ 360 million in developing two oil blocks in Africa's largest energy producing country. Indian oil companies were also asked to intensify the exploration of oil in Nigeria.

Furthermore, India wants to partner with the Nigerian National Petroleum Corporation (NNPC) through the Indian oil and gas conglomerate, Oil and Natural Gas Corporation (ONGC-Mittal Energy), to establish a Greenfield petroleum refining plant to boost Nigeria's production of petroleum products (Walters, D., 2010). Beyond Nigeria, India is extending its engagement to other African oil producing countries such as Sudan, Côte d'Ivoire, Equatorial Guinea and Ghana (Consultancy Africa Intelligence, 2010). Additionally, in 2012 South African state oil company Petro SA and Indian Cairn Oil group signed an agreement for crude oil and natural gas exploration in the Orange basin on the West coast of South Africa. In their agreement Cairn India agreed to bring extensive geo-technical and operating capabilities to facilitate the exploration.

In Sudan, India entered a deal in 2003 through its ONGC Videsh to produce Sudan's oil, having invested \$750 Million, acquiring a 25% partnership in the Great Nile Petroleum (GNP) operating company. Moreover, India has supported the building of an oil pipeline linking Khartoum and Port of Sudan on the red sea at a cost of \$200million (Vines, A., 2010). The above undertakings are examples by which some diffusion of technology and practical skills take place. They entail involvement of the people of Africa employed during the establishment and operations of the investments by Indian Companies.

⁵ <http://www.africa-business.com/features/indians-africa-farmlands.html>

2.2.3 Trade

There is mutual recognition that enhanced trade and economic linkages will contribute to sustainable growth and economic development as well as technology transfer.. India has been exporting to Africa a wide range of products. These *inter alia* include High Speed Diesel (HSD), Aviation Turbine Fuel (ATF), medicines and pharmaceutical products, vehicles including motor cars such as (Tata) and motor cycles e.g. (Bajaj), electrical machinery & equipments, mineral/ chemical fertilizers, other motor spirits, tyres used on buses/lorries, printed books, polypropylene (a polymer used in a wide variety of applications including packaging, textiles etc.), garments, fabrics, household articles of stainless steel and so on. On the other hand, India generally has been importing petroleum oils and its by products minerals, unwrought forms of gold, coal, copper ores & concentrates, manganese ore, cobalt ores & concentrates, natural calcium phosphates, ground and other different ores, slag and ash, nuts - fresh/dried-in a shell, phosphoric acid, diamonds, unwrought silver, woods and articles thereof.

Other imports include coffee, tea, and spices from countries, to mention a few. An Economic Report from the African Development Bank (2011) reveals that bilateral trade with India has flourished rapidly during the past two decades. It grew steadily from US\$ 1 billion in 1990 to US\$ 3 billion in 2000, and then escalated to US\$ 36 billion in 2007-08 (Figure-1). Since the global financial crisis, the level has dropped to its current level of around US\$ 32 billion (2010/11). The soaring trade volumes reflect a positive trade balance for Africa, as it exports more goods to India than it imports. India’s imports from Africa grew from US\$ 587.5 million to US\$ 18.8 billion between 1990 and 2009, whilst its exports to the continent increased from US\$ 436.8 million to US\$ 13.2 billion during the same period. This trend has been encouraged in part by India’s duty-free tariff preferential scheme for 49 least developed countries (LDCs), which was announced in April 2008, and which has benefited 33 African countries.

FIGURE 1: INDIA - AFRICA TRADE VALUE 1990-2009



Source: AfDB, 2011

A good example of trade between Africa and India is Indian car maker TATA, which trades in 11 countries on the continent and has the monopoly of public transportation in Uganda and is distinctive Senegal and South Africa. India has also links with Zimbabwe through establishment of important commercial relationships. A \$1.2 billion deal between Indian

diamond, Consortium Surat Rough diamond sourcing India Ltd (SRDSIL), and Zimbabwean Mines Ministry covers exchange of rough diamonds and facilitates training in diamond, cutting and polishing to young Zimbabweans. It is an important facet of technology transfers from India (Alex Vines, 2010). In Angola commercial relationships with India also resulted in technology transfer. Endiama, Angola's largest diamond producer, agreed to do business directly with the Indian diamond industry, while India is expected to open an institute for jewellery manufacturing and a cutting and polishing centre in Luanda (Alex Vines, 2010). The above examples demonstrate that through trade, beneficial interactions between Indian business and Africa engender a more likelihood of indirect technological transfers in Africa.

3.0 BARRIERS TO TECHNOLOGY TRANSFERS FOR AFRICAN COUNTRIES

Technology transfer is a process, consisting of acquisition, learning, adaptation and diffusion. Despite the effort made by India to transfer technology in Africa as described in the previous sections, there are some barriers to technology transfer in Africa. Some forms of market failure has been particularly important barriers to technology transfers to African countries. The process of technology transfer to African countries has encountered major obstacles in the phases of learning and adaptation (World Trade Organization, 2002). There are two types of problems: firm-level problems that derive from the specific characteristics of a firm, and systemic problems that derive from the environment in which firms operate.

3.1 At the firm level

Barriers to technology transfers can be categorized into three clusters: Knowledge, Financial Capital and Organizational.

- (a) Knowledge: inadequate knowledge about all ranges of technological alternatives; and inability to identify the technology that best suits particular needs; and inadequate workforce skills and mechanisms for their upgrading;
- (b) Financial capital: limited access to finances;
- (c) Organizational: slower pace of technological development in downstream or upstream firms that inhibits the upgrading of technology; and organizational rigidities within firms.

3.2 At the systemic level

Barriers to technology transfers may also be divided into three clusters, each requiring some special interventions: education system, research and development systems and institutionalized rigidities.

- (a) Education system: lack of education and skills; and lack of resources, knowledge and capabilities within policy institutions;
- (b) Research and Development (R&D): lack of access to information on new technologies and innovations; ineffective institutions for carrying out R&D; and universities and research institutions disconnected from needs of the industry;
- (c) Institutional: market distortions, including barriers to trade; inadequate development of the financial and insurance markets; and regulatory constraints.

4.0 LESSON LEARNED FROM INDIA IMPROVEMENT IN SCIENCE AND TECHNOLOGY

The following are some of the lessons that can be learned by Africa countries with respect to the potential for technology transfer from India:-

- (a) India has put much emphasize on the importance of public research and development (R&D) in certain high-tech areas, such as transport, agriculture, information technology (IT) and pharmaceuticals. Moreover, public R&D itself has become more commercial and market-driven, responding to the needs of the private sector and the market/consumers.
- (b) The state has recognized the need to improve both the quantity and quality of scientific personnel by investing in new tertiary institutions, focusing on science and engineering education that has been a catalyst for science and technology improvement. Some of these tertiary institutions have set up branches in African countries.
- (c) India has encouraged collaboration with foreign R&D institutions, which, had a major impact to India where there has been a tremendous increase in the number of foreign R&D centers, which have grown from 100 in 2003 to about 750 by the end of 2009. The majority of these R&D centers relate to information and communication technologies (ICTs) and the automotive and pharmaceutical industries.(UNESCO, 2010)
- (d) Investing in foreign markets as a way of acquiring technology. This has been a major tool for Indians success. For example Tata Steel's takeover of the British industrial giant Corus, Bharat Forge's takeover of forging companies in Germany, the UK and the USA, and Suzlon's takeover of wind turbine companies in Germany.
- (e) Systematic support by Government offered to private and government owned companies to expand their business interest in overseas markets; both established and emerging.
- (f) Consistency in commercial and foreign trade policies over a longer timeframe.

African countries do not appear to have any systematic policies or strategies to engage and take advantage of the economic and technological advances by India. This is an area which deserves further analysis so as to advise African Policy Makers on the best options available.

5.0 CONCLUSION

The Indo-Africa relationship owes its origins to a common past that India and Africa share, particularly with respect to the struggle against colonialism, poverty and illiteracy. Yet in spite of these challenges, India has made remarkable strides since its independence (in 1948). Backed by this strength, it has increased its trade with Africa. Trade has risen from \$967 million in 1991 to more than \$9.5 billion in 2005. India's official FDI in Africa in 2008 was \$2 billion. At the same time, with the marked lag of development of African countries, especially South of the Sahara, India has set its goal to assist them accelerate their development.

A central mechanism in this relationship has been through technology transfer, with India's model of engagement revolving around ODA supported capacity building and training as well as private sector investment. India's technology transfer is imbued with vast experience in organizing small-to medium-scale activities, which are generally labor-intensive with a high potential for backward and forward linkages. The above attributes are considered more appropriate for the needs of African countries. Therefore fittingly, a significant number of African countries have collaborated with India to build key development and governance institutions in various areas and sectors. Some of these are outstanding enough to mention: like the Pan African e-Network Project, the biggest project of distance education and tele-medicine undertaken in Africa.

The others are the huge number of African students sent to study in Indian colleges and universities and a series of India-Africa collaborating institutions in different areas such as foreign trade, education, health, transport, administration, technology and human settlements as part of future capacity building for Africans. Dar es Salaam Institute of Technology (DIT) and IMTU in Tanzania as well as the Apollo hospitals in India are good examples of inter-institution collaboration.

The new frontier of Indian-Africa collaboration is oil and gas exploration and exploitation, with headways being made in Nigeria, Angola, Sudan, Côte d'Ivoire, Equatorial Guinea, Ghana and South Africa. Yet the above rosy picture is punctuated by imbalances, especially that of trade between Africa and India. While India imports more from Africa than it exports, the exports are dominated by industrial products (consumer goods, plants, medicines and pharmaceuticals, electrical goods, mineral/ chemical fertilizers, etc). Its imports are dominated by oil, minerals and agricultural raw materials. It is evident that India's progress can be tapped effectively for advancing Africa's development. Only that, this requires African countries to discern useful lessons for adaption and application in Africa. These include:

- Sufficient emphasis put in public research and development (R&D), particularly in certain high-tech areas, that is market-driven.
- State leadership in improving the quantity and quality of scientific personnel by investing in tertiary education institutions, in collaboration with Indian institutions.

- Selectivity in hosting Indian FDIs, including those that have high content of technology transfer.

Africa badly needs a specific strategy to tap more effectively on this emerging opportunity of its relationship with India for the benefit of future generations. Yet the underlying factor for successful collaboration with India will be in Africa establishing hospitable investment and business climate, installing transparency and ensuring political stability and the rule of law.

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ENDNOTES

1 Technology transfer definition vary significantly from one discipline to another including political science, economics, sociology, public policy, marketing and management of technology (Wahab, Rose et al. 2012). It can be defined as the movement of know-how, technical knowledge, or technology from one organizational setting to another. It is also referred as the transmission of know-how to suit local conditions, with effective absorption and diffusion both within and across countries (Chung, 2001). It is also defined as the process of moving results of scientific research from the laboratory to the marketplace and society (Phillips, 2002). The process can involve licensing agreements or setting up joint ventures and partnerships to share both the risks and rewards of bringing new technologies. The technological knowledge that is transferred can assume various forms. It can be embodied in goods (including physical goods, plant and animal organisms), services and people, and organisational arrangements, or codified in blueprints, designs, technical documents, and the content of numerous types of training. International technology transfer (ITT) is a comprehensive term covering mechanisms for shifting information across borders and its effective diffusion into recipient economies. It involves, complex processes, ranging from innovation and international marketing of technology to its absorption, different channels can be used, including trade in goods, foreign direct investment, technology licensing. The technology transfer concept is not only concern about the transfer of technological knowledge or information but also the technology recipient's capability to learn and absorb technology into the production function (Maskus, 2004). However in international technology transfer there is a distinction between horizontal and vertical transfers. Horizontal technology transfer consists of the movement of an established technology from one operational environment to another (for instance from one company to another). Vertical technology transfer, in contrast, refers to the transmission of new technologies from their generation during research and development activities in science and technology organisations,

for instance, to application in the industrial and agricultural sectors

- 2 Knowledge is a process involving people and human action. Davenport and Prusak (1998) defines knowledge as a “ fluid mix of framed experience, values, contextual information and expert insights that provides a framework for evaluating and incorporating new experiences and information and that it originates and is applied in the minds of knowers, it is not only embedded in documents and repositories but also in organisational routines, processes, practices and norms”. Knowledge has been classified by various authors as either as tacit (uncodified) or explicit (codified). Tacit knowledge is acquired by practical or personal experience and explicit knowledge is knowledge that has been formally articulated. Knowledge transfer can be defined as a process of knowledge creation and application, knowledge mobilization and exchange, information search and transformation as well as the learning process at and outside the workplace. Knowledge transfer mechanisms include personnel movement, guided learning-by doing, learning by observation, in-house or off-house training, replication and innovative activities, scientific publications and presentations, interaction among employees (team work), working with experts/expatriates and coaches/mentors, alliances and inter-organization relationships (Awang, Hussain et al. 2009). Cordey-Hayes and Gilbert (1996) have described knowledge transfer as a means by which organisations can implement and appropriate new technology. Many scholars view knowledge transfer as the capacity of the firm to recognise the value of internal and external information and to use it for commercial ends, and enabling firms to have a competitive advantage. Knowledge transfer is recognised as critical factor for a firm to rapidly respond to changes, innovation and achieve competitive success. Knowledge can be generated by domestic firms in an economy, it spills via various channels such as foreign direct investment into an economy (Majumdar, 2009).

ESRF is an independent, non-governmental research institute registered in Tanzania with offices in Dar es Salaam. Its operations began in April 1994 in response to the need for the development of an institutional capacity for policy analysis. The foundation conducts policy-related research, capacity building programmes and policy dialogues that enhance the understanding of policy options within the government, the business community, the donor community, civil society and the growing private sector. It also undertakes demand-driven commissioned studies that conform to its mission.

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